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AN ECONOMIC STUDY OF CATTLE BUSINESS ON A SOUTHWESTERN SEMIDESERT RANGE

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INTRODUCTION

The range business of the semidesert grassland region of the Southwest consists mainly in the production of young range cattle, principally calves and yearlings. Yearlong use of these ranges favors this type of breeding enterprise. Most of the cows on a given range are retained from year to year. Thus the common basis of the cattle operations is the breeding herd, and the comparable unit on which the earnings are based is breeding cow[3]—that is, as the breeding herds are the sources of returns, it is logical that

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[1]Maintained at Tucson, Ariz., by the Forest Service, U. S. Department of Agriculture in co-operation with the University of Arizona.

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[3]For the purpose of this paper, the term "breeding cow" means a female animal of any breeding herd, either wet or dry, at least 20 months old, and which produces its first calf at 2½ or 3 years of age; hereinafter referred to as cow.

cattlemen should think of the economics of their business in terms of receipts, costs, and earnings per cow.

Most range users have some general knowledge of the main costs and the principal factors that affect receipts; but only a comparatively few know the detailed costs. It is generally recognized that, regardless of whether cost records are kept, net profits, simply stated, is the difference between gross receipts and total cost. Thus cost accounting on ranges may seem unnecessary. Nevertheless, there is a point of view regarding the economics of the cattle business that should not be overlooked, namely, the advantages that may be gained in keeping cost records and in thinking more in terms of costs and earnings per cow and cost of producing a calf (considering all charges), a line of thinking similar to that in other business enterprises.

Continuation of the cattle business through preservation of the ranges is the first fundamental; and when ranges are stocked in accord with this view, there comes the assurance of adequate forage through a period of years. Then the economics of the cattle business, from the point of view of profit, might well center on cost per cow and calf and, particularly, on earnings per cow. Further, when expenditures are involved for fences, water developments, and the like, it will not be a question simply of total cost, which may not seem very much, but rather how much will proposed expenditures increase the costs per cow and calf, and, more important still, how much additional cost could a cow or calf carry with profit.

It was with a view to testing the soundness of such business reasoning, as outlined above, that an economic study of a cattle operation was made on the Santa Rita Experimental Range in southern Arizona. This project, which was conducted on semidesert grassland typical of the low mesas of the Southwest, was begun in 1924 and concluded in 1934. This bulletin gives the results of this study, and discusses certain phases of the cattle business that may be of value to cattlemen on similar ranges.

RANGE CONDITIONS ON SANTA RITA

The grasslands of the Santa Rita Experimental Range comprise an out-wash plain that extends from a low mesa adjoining Santa Cruz Valley southeastward to Santa Rita Mountains, rising gradually in elevation from 3,000 to 4,800 feet. The lowest part is comparatively level, while the intermediate and upper parts constitute a "rolling" mesa. Adjoining the mountains are some rather steep hillsides and well-defined canyons. Except for a small area near the mountains, the topographic relief favors cattle movements. Of the 49,759 acres in the experimental range, this study involved the use of 24,700 acres, including high, medium, and some of the lowest lands.

Climate

Because of the difference of 1,800 feet in elevation between the lowest and highest lands, the climate varies from near-desert of the low country, which has an average annual rainfall of 12.6 inches, to nearly subhumid of the areas that border the mountains,

where the precipitation averages slightly more than 18 inches. The mean temperatures are moderate. For the low country, they range from 57° F. during fall and winter (Oct. to Jan., incl.) to 81° during summer (June to Sept., incl.); and at higher elevation near the mountains, from about 54° in winter to about 78° in summer.

Forage Plants

The upper range, about 4,000 feet, supports slender grama (Bouteloua filiformis), spruce-top grama (B. chondrosioides), curly-mesquite (Hilaria belangeri), hairy grama (Bouteloua hirsuta), and other grasses, forming a rather heavy stand. The common browse plants are velvet mesquites (Prosopis velutina), catclaws (Acacia greggii), and false-mesquites or calliandras (Calliandra eriophylla). (Fig. 1, A.) Here, because of good growth of grasses, annuals are of little importance.

Lower down, between elevations of 3,400 and 4,000 feet, Rothrock grama (Bouteloua rothrockii), three-awns (Aristida spp.), and black grama[4] (B. eriopoda), predominate. Browse plants include mesquite trees and catclaw, spiny hackberry (Celtis pallida), and scattered calliandra and baccharis (Baccharis wrightii) shrubs. A few cacti (Opuntia spp.) are also present. (Fig. 1, B.) As on the upper range, annuals contribute but little forage.

The low country, at elevation varying from 3,000 to 3,400 feet, supports such browse plants as mesquite, catclaw, hackberry, false-

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[4]Black grama is locally known in some places as crowfoot grama.

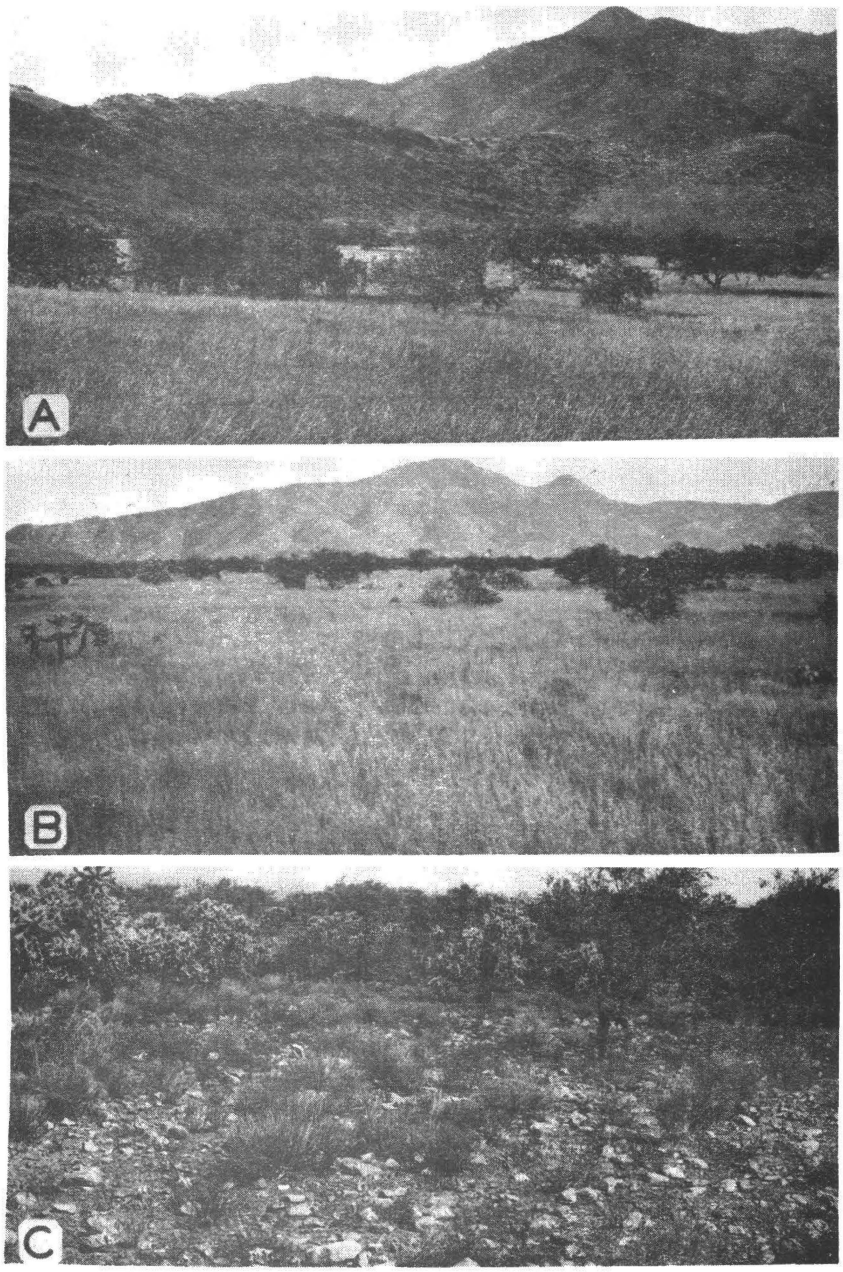

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Figure 1.—Grazing lands on Santa Rita Experimental Range. A, Upper range bordering Santa Rita Mountains. Here the grasses are principally slender, spruce-top, and hairy gramas, and curly-mesquite. The taller growths are mesquites. B, Middle range, where Rothrock grama, three-awns, and black grama are predominant. The plants growing above the grasses are mostly mesquites and a few cacti. C, Lower land which was brought under control in 1926 and which had suffered from overgrazing and surface soil erosion. Here there are remnants of such grasses as bush muhly, fluffgrass, three-awns, Arizona cottongrass, and tanglehead. The shrubs are mainly mesquites, catclaws, hackberries, and cacti.

mesquite or calliandra, and range ratany or krameria (Krameria glandulosa) shrubs. There are also grasses, largely remnants, including bush muhly (Muhlenbergia porteri), fluffgrass (Triodia pulchella), three-awns, Arizona cottongrass (Trichachne californica syn. Valota saccharata), tanglehead (Heteropogon contortus), sacatons (Sporobolus airoides, S. wrightii), vine-mesquite or vine panic (Panicum obtusum), and others. Common annuals are gramas, three-awns, spurges (Chamaesyce spp.), Indianwheats (Plantago spp.), purslanes (Portulaca spp.), and ragweeds (Ambrosia spp.). Cacti are common. (Fig. 1, C.)

Grazing Conditions

The grasses on the Santa Rita range usually start growing the latter part of June and cease their growth the latter part of September. During this growing season considerably more rain usually occurs than the combined fall of the 8 winter and spring months. A dry period, which commonly begins during the fore part of March, usually precedes the period of summer rains. During winter and early spring, rains are somewhat irregular, and perennial grasses make little or no growth, principally because of low temperatures. During the spring months (Feb., Mar., Apr., May), minimum temperatures allow grass growth only when rainfall is adequate. Thus, ordinarily, during the winter and dry spring months, the perennial grasses constitute dry or cured forage.

The perennial grasses supply by far the greater part of the forage. During summer and early winter they are supplemented with browse plants (mesquites, catclaws, false-mesquites, and Kramerias),

annual summer grasses, three-awns, and various forbs,[5] such as spurges and purslanes. Cattle show a preference for the perennial grasses during all seasons of the year. Browse is the only supplement to the cured forage during late winter. In the spring, particularly the latter part, browse plants constitute an important source of forage whenever the supply of grass forage is low. When the rainfall is favorable during spring, certain annual forbs, such as Indianwheats, supplement the dried grasses. Ordinarily these forbs cannot be depended upon to supply any appreciable quantity of forage.

The foregoing brief sketch of grazing conditions is given to show that the Santa Rita range is typical of the mixed-grass semidesert ranges of the Southwest on which there are no natural conditions that would afford opportunities to regulate cattle movements, such as from high-mountain or summer to low-elevation or winter range and from one seasonal-forage area to another. Nevertheless, some regulation of cattle movements is carried into effect through judicious salting, and sometime by fencing, in order to obtain as even utilization of forage as possible over the range and particularly to prevent concentration of cattle around the watering places.

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[5]Forbs are any herbs other than grass and grasslike plants, and are commonly called weeds.

HOW THE STUDY WAS CONDUCTED

During the first 4 years of this study (1924-27, incl.), 6,000 acres of good range and, on the average, 235 breeding cows were considered. In 1928 an area of 18,700 acres was added, much of which had rather low grazing capacity, and the herd was more than doubled. The total range acreage was thus increased to 24,700 acres, which carried, on the average, 494 cows for the remaining period from 1928 to 1934. The added acreage of lands of low grazing capacity—8,000 acres—were lands that had been overgrazed and which were brought under control in 1926.

Records

As near complete records were kept as were possible, including receipts, disbursements, indirect charges, calf crops, and cattle losses. The receipts were grouped according to classes of cattle sold, such as cows, yearlings, and calves. The charges were grouped, for convenience, into three principal classes, namely, running costs or cash expenditures, indirect charges, and interest charges on capital invested.

Expenditures were for interest, hired labor (including groceries for laborers), grazing charge, overhead (misc. small expenses), bull replacements, taxes, motor-car operation, freight and hauling, salt, feed (grain, hay, meal, principally for horses), pump-engine operation, inspection and weighing, ranch equipment (small movable, such as tools, wagons, and "fresnos"), and vaccine.

Indirect charges included cow replacements, depreciation of range improvements, and cattle losses.

"Interest charges on fixed capital" involved no actual running costs or cash expenditures. All items entered here are interest charges at 6 percent on money invested in cattle, land, and improvements (headquarters, water developments, fences, and large equipment like trucks, windmills, and pumps). The amount invested in cattle was determined each year by the average selling prices of the various classes of cattle sold. No allowance was made for cost of marketing which, on the Santa Rita range, is practically negligible, owing to nearness to the shipping points. The cost plan of inventorying to determine capital invested, as is commonly done in going concerns, was found impossible to apply in the Santa Rita study. Hence the market-value[6] plan had to be used, although according to Collins,[7] it is not altogether correct in theory.

"Interest charges on fixed capital" (cattle, improvements, land) were considered at 6 percent, because this rate is generally recognized as the average percentage earnings if and when an operator sells out and loans his money for various purposes. There were some interest payments made on borrowed capital and temporary loans, and hence charged as cash expenditures. In order to prevent double interest charges, these cash payments were deducted from the total "interest

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[6]Market value as used in this report means the price received f.o.b. the Santa Rita shipping point, as most of the Santa Rita cattle were sold on this basis.

[7]Kester, Roy B., and collaborators. accounting, theory and practice, v. 3, ch. 6. New York, 1922.

charges on fixed capital." (See table 2.) To illustrate: The 6-percent interest charges on the total fixed capital averaged $2.71 plus $1.35 plus $0.10, or $4.16 per cow. But the "Credit" of $2.07 per cow (last column table 2, 3rd line from bottom), represents 6 percent on the borrowed capital. The difference between $4.16 and $2.07, or $2.09 (2nd line from bottom of last column) is the average interest charge on the operator's own capital.

EARNINGS PER COW

The results pertaining to income fall logically into two main categories, as determined by the character of the cattle business of the semidesert Southwest, which are (1) items from which the earnings per breeding cow may be ascertained, and (2) items from which the cost of producing young range cattle may be determined. Three principal sets of results that pertain to the earnings of the breeding herd are given, namely, receipts, running cost, and a financial or profit-and-loss statement.

Receipts

The gross annual receipts averaged $26.44 per cow (table 1). Nearly 69 percent of these receipts came from the sale of calves; and slightly more than 29 percent, from the sale of cows and yearlings. There was a wide range in total annual receipts per cow from $13.56 in 1932 to $49.27 in 1928—owing principally to fluctuations in market prices.

Table 1.—Gross receipts per cow from the sales of all classes of cattle

Class	Receipts per cow by years											Average[1]
	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Calves. . .	15.90	14.66	14.13	23.13	31.88	28.92	24.59	17.89	11.18	12.09	10.70	19.24
Cows. . . .	9.45	0.00	0.18	11.79	11.34	7.36	3.13	0.25	1.96	2.76	3.18	4.50
Yearlings .	0.12	2.42	10.81	3.95	5.95	0.00	0.51	0.00	0.42	1.37	1.76	2.17
Bulls . . .	0.00	0.00	0.00	2.85	0.00	1.84	0.00	0.00	0.00	0.00	0.78	0.39
Steers. . .	0.00	2.66	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.14	0.00	0.14
Total . . .	25.47	19.74	25.12	41.72	49.27	38.12	28.23	18.14	13.56	16.36	16.42	26.44

[1]Formed by dividing total amount for 11-year period by the sum f the annual numbers of ccws.

Cost per Cow

When all costs and charges are counted, the total annual cost of the Santa Rita breeding herd averaged $20.81 per cow for the 11-year period. This cost includes $10.57 for running costs or cash expenditures, $8.15 for indirect charges, and $2.09 for interest charges on fixed capital. The detailed items are summarized in table 2.

These costs do not include any charges for the operator's time and ability. Such an item was omitted, because whatever net returns an operator realizes above all charges is commonly regarded as his earnings or remuneration for conducting his business.

Some of the expenditures per cow were rather uniform for the 11-year period, such as taxes, grazing charges, interest, and motor-car and pump-engine operations. Other expenses varied widely, partly because of variation in prices and in quantity of material purchased, and partly because the payments were entered when the money was paid out, as some of the labor payments, the bull replacements, and for salt—that is, supplies or materials purchased near the close of one year were sometime paid for the following year.

The total costs varied widely. In 1926 they were exceptionally low ($10.20 per cow) largely because there were no bull replacements, and there were only small charges for cow replacements and losses. The excessively high cost of $34.56 per cow in 1928 was the result of heavy cow and bull replacements.

The small average interest charge of 10 cents per cow for capital invested in land indicates only a comparatively small acreage

Table 2.—Annual cow cost on Santa Rita Experimental Range

Item	Detailed cost per cow by years											Average[1]
	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	
CASH EXPENDITURES (Running costs)	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Interest paid[2]	3.13	2.45	1.57	2.95	4.26	2.60	3.97	2.70	2.40	2.75	3.80	3.07
Labor (hired, incl. groceries)	0.76	2.65	1.41	2.64	2.78	1.85	2.13	1.97	1.80	1.86	1.81	2.00
Grazing charge	1.50	1.74	1.51	1.58	1.58	1.72	1.59	1.63	1.67	1.63	1.93	1.65
Overhead (misc. small expense)	0.56	1.69	1.37	1.91	1.16	0.41	1.28	0.72	0.78	0.99	0.74	0.98
Bull replacement	0.00	0.00	0.00	0.00	4.91	0.00	0.00	2.35	0.00	0.00	0.00	0.91
Motor-car operation	0.25	0.26	0.24	0.24	0.36	0.51	0.43	0.30	0.34	0.65	0.62	0.41
Taxes on cattle	0.25	0.31	0.16	0.34	0.44	0.50	0.51	0.29	0.28	0.22	0.27	0.34
Freight and hauling cattle[3]	0.84	0.00	0.00	0.00	0.03	0.00	0.32	0.86	0.61	0.28	0.00	0.29
Salt	0.00	0.03	0.19	0.15	0.08	0.15	0.59	0.12	0.23	0.10	0.28	0.19
Feed (mainly for horses)	0.14	0.00	0.02	0.09	0.00	0.20	0.11	0.23	0.09	0.39	0.31	0.16
Engine operation (pumps)	0.13	0.16	0.11	0.16	0.13	0.20	0.16	0.10	0.10	0.10	0.12	0.13
Inspection and weighing[3]	0.16	0.13	0.12	0.13	0.12	0.09	0.14	0.09	0.12	0.18	0.12	0.12
Taxes on equipment	0.07	0.09	0.04	0.07	0.09	0.11	0.12	0.06	0.06	0.04	0.06	0.08
Freight and hauling (misc.)	0.00	0.00	0.00	0.06	0.01	0.02	0.32	0.10	0.10	0.01	0.14	0.08
Ranch equipment (small movable)	0.10	0.00	0.00	0.01	0.00	0.04	0.04	0.06	0.12	0.05	0.20	0.06
Taxes on land	0.04	0.04	0.02	0.05	0.07	0.08	0.08	0.04	0.04	0.03	0.04	0.05
Vaccine	0.00	0.00	0.00	0.00	0.03	0.00	0.06	0.13	0.05	0.05	0.10	0.05
Total	7.93	9.55	6.76	10.38	16.05	8.48	11.85	11.75	8.79	9.33	10.54	10.57
INDIRECT CHARGES												
Cow replacement[4]	9.62	0.00	0.18	11.79	11.34	8.47	3.14	0.30	1.54	2.12	3.23	4.52
Depr. of improvements	1.15	1.55	1.05	1.70	1.71	2.48	2.88	2.97	2.88	2.80	3.51	2.44
Cattle losses	1.40	2.34	0.27	1.60	2.07	1.75	1.30	0.70	0.65	0.78	0.84	1.19
Total	12.17	3.89	1.50	15.09	15.12	12.70	7.32	3.97	5.07	5.70	7.58	8.15
INTEREST CHARGES ON FIXED CAPITAL												
Cattle	2.63	2.71	2.00	3.40	5.16	3.14	3.14	1.90	1.82	1.70	1.88	2.71
Improvements (fixed on headquarters and on range)	0.68	0.74	0.49	0.60	1.10	1.29	1.36	1.70	1.78	1.66	1.95	1.35
Lands	0.13	0.15	0.10	0.15	0.08	0.10	0.09	0.08	0.08	0.08	0.11	0.10
Credit[5]	2.29	0.96	0.65	2.12	2.95	1.95	2.75	1.76	1.75	1.76	2.68	2.07
Actual charge	1.15	2.64	1.94	2.03	3.39	2.58	1.84	1.92	1.93	1.68	1.26	2.09
Grand total charges	21.25	16.08	10.20	27.50	34.56	23.76	21.01	17.64	15.79	16.71	19.38	20.81

[1] Formed by dividing total amount for 11-year period by the sum of the annual numbers of cows.
[2] Includes interest on borrowed fixed-capital money as well as on temporary loans.
[3] Most of the cattle were shipped f.o.b. the Santa Rita shipping point. See "Shipping points" under "Marketing."
[4] Replacement costs were computed on the basis of average market value, as determined by Santa Rita sale figures, in order to arrive at an average yearly valuation.
[5] Credit for interest actually paid on borrowed-fixed-capital money and already charged as expenditure.

owned by the operator. Practically all the grazing lands considered in this study are Government owned, hence the grazing charge, which averaged $1.65 per cow annually.

Financial Statement (Breeding Cows)

A summary of the receipts, costs, and net proceeds per cow is given in table 3. This statement shows in sucessive stages, or at different points in the Santa Rita operation, what items have been taken into account in arriving at the net proceeds. Moreover, such a statement will enable an operator who has cost figures to make comparisons with these data and also to enable him to analyze his own business in a similar manner.

The net earnings realized by the Santa Rita operator averaged $5.63 per cow annually. Inasmuch as the number of cows in the breeding herd averaged 394 for the 11-year period, the total annual net profits amounted to $2,218.22, which is the average annual amount the operator received for his labors, exclusive of the interest he received on his investment. The total net proceeds from all sales ranged from a loss of $2.96 per cow in 1934 to a net profit of $14.92 in 1926. The losses for 1932, 1933, and 1934 resulted largely from a decline in market prices. In 1933 the market decline was partly offset by the sale of more calves and a few more yearlings than were sold the previous year.

The losses indicated for 1932, 1933, and 1934 were not actual money losses. In 1932, in addition to paying all bills, the operation met all indirect charges, except 30 cents per cow; but there were no

Table 3.—Financial statement (breeding cows)

Item	Gross receipts, charges, and net proceeds per cow by years											Average[1]
	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Gross receipts. . . .	25.47	19.74	25.12	41.72	49.27	38.12	28.23	18.14	13.56	16.36	16.42	26.44
Less cash expenses.	7.93	9.55	6.76	10.38	16.05	8.48	11.85	11.75	8.79	9.33	10.54	10.57
Receipts exclusive of indirect charges and interest on money invested	17.54	10.19	18.36	31.34	33.22	29.64	16.38	6.39	4.77	7.03	5.88	15.87
Less indirect chgs..	12.17	3.89	1.50	15.09	15.12	12.70	7.32	3.97	5.07	5.70	7.58	8.15
Receipts exclusive of interest on invested capital.	5.37	6.30	16.86	16.25	18.10	16.94	9.06	2.42	-0.30	1.33	-1.70	7.72
Less interest on capital invested. .	1.15	2.64	1.94	2.03	3.39	2.58	1.84	1.92	1.93	1.68	1.26	2.09
Net proceeds.	4.22	3.66	14.92	14.22	14.71	14.36	7.22	0.50	-2.23	-0.35	-2.96	5.63

[1]Formed by dividing total amount for 11-year period by the sum of the annual numbers of cows.

earnings. In 1933, all bills were paid and all indirect charges were met. Interest earnings, however, fell short by 35 cents per cow. In 1934 the business paid all cash expenditures but fell short of covering the indirect charges by $1.70 per cow.

NOTES REGARDING CERTAIN COW-COST CHARGES

The net proceeds, or earnings, of $5.63 per cow do not include interest on investment. The interest on fixed capital averaged $2.09, which is additional income. Further, there are elements of gain in both "cow replacements" and "cattle losses", as used in this paper. Other factors that have important relations to proceeds are range privileges or control and depreciation of improvements. These factors will be discussed in the order named.

Cow Replacements

For the most part, the replacement of aged or otherwise undesirable cows sold was made with heifers, a few of which grew up on the study range; but most of them were from animals that the operator had removed when calves to other of his adjoining ranges, and when grown were returned in making replacements. A few replacement heifers were produced and raised on the operator's adjoining ranges.

All calves and heifers removed from the range were credited as sales. Hence the replacement heifers were charged against the operation at their market value, just as though they were purchased outright. The living cows they displaced were credited as sales. The

cost of raising heifers to replacement age was less than their market value, hence there was an element of gain here. Further, the cows culled from the herd commonly brought more on the market than the heifers that displaced them would have brought. Inasmuch as some operators buy replacement animals, the treatment given this item seems reasonable.

Cattle Losses

Replacements of cattle lost as the result of diseases and other causes were made largely from animals that were produced on the area studied, but which had been removed when calves to adjoining ranges and brought back when grown whenever replacements were necessary. Owing to the fact that these replacement cattle were charged against the operation at their market value, which was somewhat greater than the actual cost of raising them, introduces into the item of "Cattle losses", as in "Cow replacement", an element of gain.

The cattle-loss item includes all recorded losses as well as a few head that disappeared, the carcasses of which were never found. Whenever there was any indication of an animal loss, a loss was recorded. In each instance the current market value (as used in this paper) determined the monetary loss incurred.

Range Privileges or Control

No interest charge was entered for range privileges or control, which are common intangible assets on semidesert ranges of the Southwest. It is a common practice of stockmen to pay premiums for the right to control range lands—that is, payments in addition to those

for cattle, improvements, and the like. Such privileges, although not legally recognized, are commonly bought and sold. This explains, for example, the high prices that are paid for certain key ranches that control much larger areas of range lands.

Depreciation of Improvements

Many of the Santa Rita improvements—fences, water developments, corrals—were already in place in 1924 when this study was started. Additional improvements were made by the operator since that time. All improvements that were already in place were evaluated each year by taking the original cost and deducting therefrom depreciation up to the year considered. Thus the value taken for the original improvements in 1924 was their original cost less depreciation up to that year. The improvements that were put in since 1924 were charged at their full cost the year following their construction; and in subsequent years, at their cost less depreciation.

The charges for depreciation were based on the probable life of each improvement. Fences were estimated to have a life of 20 years; thus 1/20 of the original cost was charged as depreciation each year. The life of trucks was considered at 5 years, and thus there was an annual depreciation of one-fifth of their original cost.

Although the depreciation item is purely an estimate and is not the actual maintenance cost of the improvements, experience has shown that estimated depreciation and actual maintenance cost balance fairly well. Some improvements last longer than their estimated life, whereas others last for slightly shorter periods than was estimated.

In table 2 there is a slight, unavoidable duplication of cost in the depreciation and labor items, owing to the fact that light, occasional, maintenance jobs were done by the laborers, and such repair work was included in the regular labor charge. For the 11-year period, the maintenance work done in this way amounted to only a small sum.

COST OF PRODUCING A CALF

The calves were sold at the age of 8 or 9 months. Owing to the fact that the calf crop varied from 75.3 to 88.8 percent of the number of breeding cows, the various costs (the detailed items of which are the same as those for cows) are from 12.4 to nearly 33 percent higher per calf than those given per cow (table 2), averaging, according to the 11-year means, 20.7 percent greater, as shown in table 4.

The total cost of producing a calf averaged $25.11, which includes $12.76 for all running costs or cash expenditures, $9.84 for indirect charges, and $2.51 for interest on capital invested.

Table 4.—Yearly cost of producing range calves to marketable age

Item	Detailed cost per calf by years											Average[1]
	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	
CASH EXPENDITURES (Running costs)	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Interest paid	3.61	3.85	1.98	3.61	5.06	3.27	4.67	3.03	2.89	3.43	4.80	3.71
Labor	0.88	3.92	1.78	3.22	3.31	2.32	2.50	2.22	2.16	2.32	2.29	2.41
Grazing charge	1.73	2.32	1.90	1.93	1.88	2.16	1.87	1.63	2.00	2.03	2.44	2.00
Overhead	0.64	2.24	1.72	2.33	1.38	0.52	1.50	0.81	0.94	1.23	0.94	1.18
Bull replacement	0.00	0.00	0.00	0.00	5.85	0.00	0.00	2.64	0.00	0.00	0.00	1.10
Motor-car operation	0.29	0.35	0.30	0.29	0.43	0.64	0.50	0.33	0.40	0.81	0.78	0.49
Taxes on cattle	0.29	0.41	0.20	0.42	0.53	0.63	0.60	0.32	0.34	0.27	0.35	0.41
Freight and hauling cattle[2]	0.97	0.00	0.00	0.00	0.04	0.00	0.38	0.97	0.73	0.36	0.00	0.35
Salt	0.00	0.04	0.24	0.19	0.10	0.18	0.70	0.13	0.27	0.12	0.35	0.23
Feed	0.16	0.00	0.02	0.12	0.00	0.25	0.13	0.25	0.11	0.49	0.40	0.19
Engine operation	0.15	0.21	0.14	0.20	0.16	0.25	0.18	0.11	0.11	0.12	0.16	0.16
Inspection and weighing[2]	0.19	0.18	0.15	0.16	0.14	0.12	0.16	0.10	0.14	0.22	0.15	0.15
Freight and hauling (misc.)	0.00	0.00	0.00	0.07	0.02	0.03	0.38	0.11	0.12	0.01	0.17	0.10
Taxes on equipment	0.08	0.12	0.06	0.08	0.11	0.14	0.14	0.07	0.07	0.06	0.07	0.09
Ranch equipment	0.11	0.00	0.00	0.01	0.00	0.06	0.05	0.06	0.14	0.06	0.25	0.07
Taxes on land	0.04	0.06	0.03	0.06	0.08	0.10	0.09	0.05	0.05	0.04	0.05	0.06
Vaccine	0.00	0.00	0.00	0.00	0.04	0.00	0.08	0.15	0.06	0.06	0.12	0.06
Total	9.14	12.70	8.52	12.69	19.13	10.67	13.93	13.18	10.53	11.63	13.32	12.76
INDIRECT CHARGES												
Cow replacement	11.11	0.00	0.23	14.41	13.51	10.64	3.68	0.34	1.85	2.65	4.08	5.46
Depr. of improvements	1.33	2.06	1.33	2.08	2.06	3.10	3.37	3.34	3.44	3.47	4.43	2.94
Cattle losses	1.61	3.11	0.34	1.95	2.47	2.20	1.53	0.79	0.78	0.97	1.07	1.44
Total	14.05	5.17	1.90	18.44	18.04	15.94	8.58	4.47	6.07	7.09	9.58	9.84
INTEREST CHARGES ON FIXED CAPITAL												
Cattle	3.04	3.61	2.52	4.16	6.15	3.95	3.69	2.14	2.18	2.11	2.37	3.27
Improvements	0.79	0.98	0.61	0.74	1.31	1.62	1.59	1.92	2.13	2.07	2.47	1.63
Lands	0.15	0.20	0.13	0.19	0.09	0.12	0.10	0.10	0.10	0.11	0.14	0.12
Credit	2.64	1.28	0.82	2.59	3.52	2.45	3.23	1.98	2.10	2.20	3.39	2.51
Actual charge	1.34	3.51	2.44	2.50	4.03	3.24	2.15	2.18	2.31	2.09	1.59	2.51
Grand total charges	24.53	21.38	12.86	33.63	41.20	29.85	24.66	19.83	18.91	20.81	24.49	25.11

[1] Formed by dividing total amount for 11-year period by the sum of the annual numbers of cows.

[2] Most of the cattle were shipped f.o.b. the Santa Rita shipping point. See "Shipping points" under "Marketing."

Financial Statement (Calves)

The gross receipts per calf, based on sales of all classes of animals, averaged $31.99 for the 11-year period, giving net proceeds of $6.88 per calf. There are wide differences in the net returns, varying from an apparent loss of $3.76 in 1934 to a profit of $18.75 in 1926 (table 5). The explanation given for the losses in the financial statement for cows applies also to the losses indicated in the financial statement for calves.

Of the various items studied, the following three have outstanding importance, so far as the economics of the southwestern cattle business is concerned: cost to run a cow, cost to produce a calf, and, most important, earnings per cow. In the operation considered, it cost, on the average, $20.81 per cow to run the breeding herd; it cost $25.11 to grow a calf to the marketable age of 8 or 9 months; and the earnings per cow averaged $5.63. The costs per cow and per calf represent one and the same general cost, namely, that of running the breeding herd. The relation between operating cost and earnings of the breeding herd is of vital importance to every operator.

FACTORS AFFECTING COSTS AND EARNINGS

Several factors affected the costs and earnings, among which may be named range management, calf crop, cattle losses, grade of cattle, and marketing. Other factors are shipping points and annual rainfall. Inasmuch as most of these factors operate on other south-

Table 5.—Financial statement (calves)

Item	Gross receipts, charges, and net proceeds per calf by years											Average[1]
	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Gross receipts	29.39	26.23	31.61	51.00	58.70	47.88	33.15	20.42	16.25	20.41	20.73	31.99
Less cash expenses	9.14	12.70	8.52	12.69	19.13	10.67	13.93	13.18	10.53	11.63	13.32	12.76
Receipts exclusive of indirect charges and interest on money invested	20.25	13.53	23.09	38.31	39.57	37.21	19.22	7.24	5.72	8.78	7.41	19.23
Less indirect charges	14.05	5.17	1.90	18.44	18.04	15.94	8.58	4.47	6.07	7.09	9.58	9.84
Receipts exclusive of interest on invested capital	6.20	8.36	21.19	19.87	21.53	21.27	10.64	2.77	-0.35	1.69	-2.17	9.39
Less interest on capital invested	1.34	3.51	2.44	2.50	4.03	3.24	2.15	2.18	2.31	2.09	1.59	2.51
Net proceeds	4.86	4.85	18.75	17.37	17.50	18.03	8.49	0.59	-2.66	-0.40	-3.76	6.88

[1]Formed by dividing total amount for 11-year period by the sum of the annual numbers of calves.

western ranges—those similar to the area studied—they will be briefly discussed. Over most of these factors the operators can exercise more or less control.

Range Management

On the Santa Rita range, grazing capacity for sustained yields was given full consideration, also salting for as even utilization of forage as possible, particularly to avoid concentration of cattle around watering places.

Range conservation, which has been mentioned as the first fundamental in grazing, and stocking accordingly, gave the operator the assurance of adequate forage through the years, and thus eliminated the problem of supplemental feeding. Moreover, conservative stocking led to economic thinking that brought into prominence not only running cost per cow, cost per calf, and earnings per cow but also certain factors that influenced these costs and earnings. Such thinking displaced the idea all too common on southwestern semidesert ranges, namely, the basing of the cattle business largely on total number of animals—that is, more cattle, more returns. But "total number" has proved to be the stamp of temporary operations, for such practice has already told its story in the deterioration of many ranges. It has modernized the old story of killing the goose that laid the golden egg.

With respect to control of cattle movements, salt was placed both at and away from watering places. At times salting at water proved to be desirable, especially in late winter and during spring

of certain years, when cattle were subnormal, following periods of subsistence on dry forage. But when cattle were normal or strong, salting out from water, even during dry-forage seasons, gave excellent results.

Not a few cattlemen have held the opinion that cattle would not go to outlying salt grounds of their own accord. But during this study it was demonstrated that cattle will go out for salt. The placing of salt at increasing distances from water, up to 2 miles, probably aided in obtaining this control of cattle movements.

Calf Crop

The calf crop on the study range averaged 82.7 percent for the 11-year period. For the same years, the estimated crop for Arizona was about 55 percent. A survey made in 1925 by Parr, Collier, and Klemmedson[8] showed that on 48 ranges on controlled lands in Arizona and southern and western New Mexico the calf crop averaged 43.5 percent of the number of cows in the breeding herd, and on 83 ranges on public domain the average was only 33.9 percent. During the same year the calf crop on the Santa Rita range was 75.3 percent, which was the lowest for the period of the study, resulting largely from the severe drought of 1924.

During 1926, 1927, 1929, 1933, and 1934, the percentage of calves fell below the average of 82.7 percent which decreases were attributed to unfavorable effects (during the years preceding

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[8] Parr, V. V., Collier, G. W., and Klemmedson, G. S. Ranch Organization and Methods of Livestock Production in the Southwest. U. S. Dept. Agr. Tech. Bull. 68, 104 pp., illus. 1928.

those named) that resulted from diminished rainfall. On the other hand, the high calf crop of 88.8 percent in 1931 was due largely to good grazing conditions during that and the 2 preceding years.

Besides good forage condition, fenced control of the range was another factor that contributed to the high average calf crop on the Santa Rita range. Fenced control enabled the operator to observe his herd at frequent intervals and to keep down losses from straying, as well as from parasites and other diseases. It also made possible good distribution of bulls. Controlled distribution was more effective than an increase in the number of bulls, as was demonstrated on another unit of the Santa Rita Experimental Range, where seven bulls per hundred cows resulted in no greater percentage of calves than on the study area, where only four bulls per hundred were used but kept well distributed.

A 6-month regulated breeding season was tried for the period from 1929 to 1934, inclusive, but with no appreciable increase in number of calves, as compared with the period from 1924 to 1928, inclusive, when there was no such regulation. However, the regulation resulted in some distinct advantages: Most of the calves were dropped over a comparatively short period in the spring, thus increasing both the uniformity of the calves and the fall sales. These combined gave a greater cash return. This also allowed the mothers to go into and through the winter in much better condition than otherwise.

Other factors that favored the calf crop were careful handling of the cows (to keep them gentle), avoidance of unnecessary movements at critical times, and culling of unproductive and aged cows.

Cattle Losses

During the period of this study, the operator's annual total cattle losses averaged 2.8 percent (table 6). Cow losses averaged as low as 2.6 percent, and calf losses, only 2.9 percent. For the same period, the annual cattle losses for Arizona ranged from 5 to more than 10 percent.

The apparently high percentage loss of yearlings on the Santa Rita range was due to the fact that there were only few animals of this class, and thus the loss of one or few gave a high percentage loss. The same explanation applied to the percentage losses of steers and bulls.

The low percentage cattle losses on the Santa Rita range may be explained largely as follows: All factors that ordinarily cause cattle losses on other or similar ranges, such as lack of feed and water, poisonous plants, diseases, and worms (particularly in calves), were given careful attention. Another factor—not the least on many ranges—was age of cows. The question of how many calves one might expect from a cow or what her term of usefulness might be is too often overlooked. Cows were not allowed to remain on the Santa Rita range beyond their time of service. One of the aims in range management was to keep under control as much as possible all cattle-loss factors. This paid good dividends in the calf crops. A summary of the causes of losses on the study range is given in table 7.

Table 6.—Losses of cattle by classes from all causes

Class	Percentage loss by years											Average[1]
	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Cows	2.2	6.0	1.1	2.6	2.3	3.3	2.4	2.0	2.2	2.4	3.7	2.6
Calves	2.6	4.3	5.1	4.6	4.9	3.0	2.5	1.7	2.1	1.7	2.1	2.9
Yearlings	100.0[2]	7.7	0.0	8.3	2.8	0.0	0.0	0.0	11.1	5.9	5.1	5.9
Steers	0.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0
Bulls	10.0	0.0	0.0	0.0	4.3	5.9	5.9	5.0	0.0	5.3	0.0	3.2
Average[3]	2.7	5.4	2.6	3.8	3.5	3.2	2.5	1.9	2.5	2.2	3.0	2.8

[1]Formed by dividing the sum of the numbers of annual losses by the sum of annual numbers of animals.
[2]Only one yearling, which died.
[3]Formed by dividing the sum of the numbers of animals lost by classes by the sum of the number of animals in each class.

Table 7.—Causes of losses of cattle

Cause	Percentage loss by years											Average[2]
	1924 (Very dry)	1925 (Dry)	1926 (Fair)	1927 (Good)	1928 (Dry)	1929 (Good)	1930 (Good)	1931 (Wet)	1932 (Rel.[1] dry)	1933 (Dry)	1934 (Rel. dry)	
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Unknown	2.3	3.5	2.6	3.5	2.6	2.5	1.4	1.4	1.9	1.4	0.9	2.0
Poisonous plants.	0.0	1.1	0.0	0.3	0.0	0.2	0.0	0.4	0.4	0.4	1.9	0.4
Worms	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.2
Accidental injury	0.2	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.2	0.1	0.1
Predatory animals	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.1
Blackleg.	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.0	Less than 0.1
Other diseases.	0.0	0.0	0.0	0.0	0.6	0.4	0.4	0.0	0.0	0.0	0.0	Less than 0.1
Lack of feed.	0.0	0.8	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.1	Less than 0.1
Lack of water	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Less than 0.1
Total	2.7	5.4	2.6	3.8	3.5	3.2[3]	2.5	1.9	2.5	2.2	3.0	2.8

[1]The rainfall in 1932 was above the average for the period, but the grasses, which had reached a peak in density and production in 1931, received a severe shock caused by the falling off of more than 13 inches of precipitation. Also, in 1932 there was a long dry period during spring and early summer and a short rainy period during summer.
[2]Formed by dividing the sum of numbers of annual losses by the sum of annual numbers of cattle.
[3]Losses found too late to determine causes, although most likely they resulted from diseases and poisonous plants.

Grade of Cattle

A few years prior to 1924 many of the cows on the Santa Rita range were of rather low grade. An important step toward improvement was the purchase of purebred Hereford bulls. The white-faced calf in figure 2, A, one of the resulting products, came from a very low-grade cow. The selection of some of the early bulls was made without sufficient consideration of their adaptability to range conditions. Later purchases were made with a view to meeting those conditions. These later bulls were accustomed to foraging, and also were larger and had better bone development (fig. 2, B). More recent purchases have included a few exceptionally good bulls (fig. 2, C) which are run with purebred cows, with the aim to producing bulls that might be used in the operation or sold to other ranchers for breeding purposes.

Special care was given to culling the off-color and otherwise undesirable cows, and displacing them with the better-grade animals. Now almost the entire herd consists of high-grade white-faced animals, many of which are almost purebreds (fig. 3, A). But best of all is the marked improvement in the principal range product, the calves (fig. 3, B), which have been given those features that qualify them for the higher market classes.

Although the purebred bulls require somewhat more care in handling than ordinary bulls, and entail some extra cost in purchases, the prices received for their offspring far outweigh their extra cost.

Here mention also should be made of the fact that conservative stocking for sustained grazing capacity, which gave the operator the

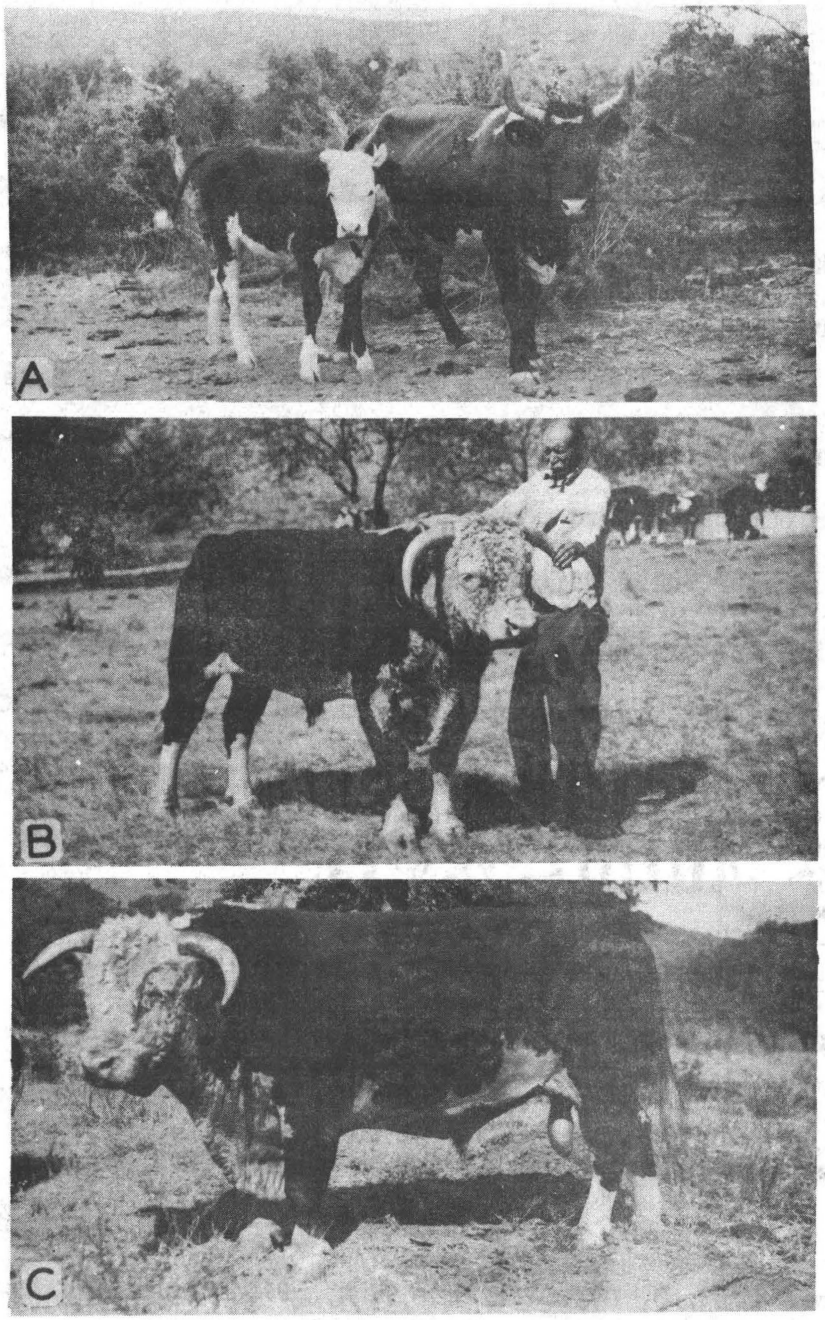

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Figure 2.—A, A white-faced calf, the product of a Hereford bull. B, Later, still better sires like this one were purchased, with better bone development and with ability to meet range conditions. C, An exceptionally good sire.

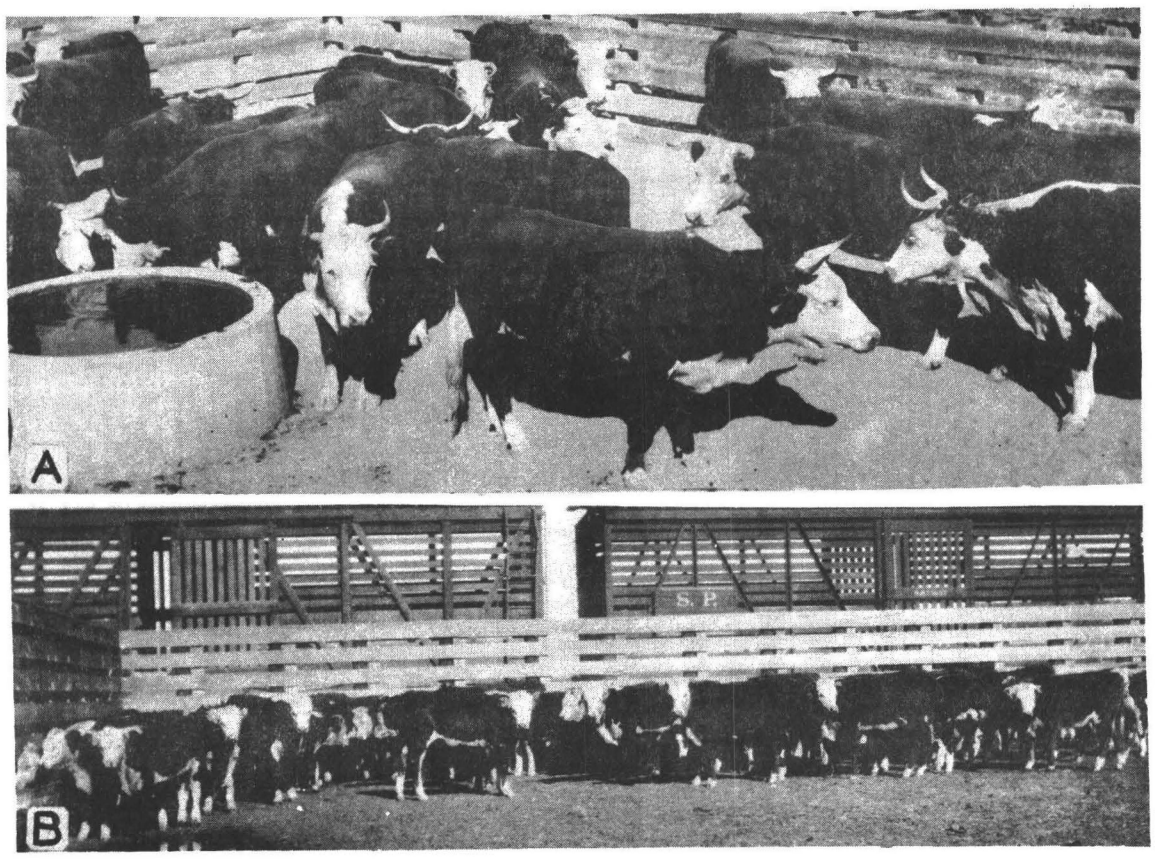

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Figure 3.—A, Better-grade animals like these displaced the less desirable cows, until the Santa Rita breeding herd became one of high-grade Herefords, many of which are almost purebreds. B, High-grade calves ready for the fall market. Note uniformity and quality, factors that qualify calves for high market classes.

assurance of adequate forage through the years, proved to be one of the major factors that made possible the improvements in the breeding herd and calves.

Marketing

The marketing plan on the Santa Rita range is to make regular annual sales. Such a practice offered two distinct advantages: (1) Hold-over animals were reduced to the minimum, thus preventing overstocking with "carry-overs", especially during drought periods. (2) The finance of the operation was put on a more stable basis than otherwise, in that the regular sales supplied funds for running expenses and improvements, thereby keeping down the amount of borrowed money and attendant interest cost.

In marketing cattle from the Santa Rita range, several factors were given considerable study, among which were classes of cattle, age of animals, time of marketing, and manner of marketing.

Classes of Cattle

Special attention was given to the marketing of calves, because they constituted the principal range product. But in the course of the operation, as on most semidesert ranges of the Southwest, other classes of cattle were also marketed—yearlings, culled and aged cows, bulls, and steers. The sales of these various classes from the Santa Rita range are summarized in table 8.

Of the total number of animals sold, slightly more than 77 percent were calves that were about 8 or 9 months old. In 1934, over half the calves were kept on the range until they were yearlings;

Table 8.—Sales of cattle on the Santa Rita study range

Class	Number and average selling price[1] by years																						Average[2]	
	1924		1925		1926		1927		1928		1929		1930		1931		1932		1933		1934			
	No.	Dol.	No.	Dol.	No.	Dol.	No.	Dol.	No.	Dol.	No.	Dol.	No.	Dol.	No.	Dol.	No.	Dol.	No.	Dol.	No.	Dol.	No.	Dol.
Calves	195	18.34	140	19.48	135	28.58	153	28.27	470	37.98	329	40.08	431	28.87	454	20.14	429	13.40	409	15.08	319	13.51	315	24.06
Yearlings	1	27.90	15	30.00	82	36.00	15	49.30	70	47.57	0	.00	8	32.40	0	.00	11	19.58	34	20.55	39	18.24	25	34.12
Cows	58	36.67	00	.00	2	25.00	49	44.99	86	73.84	83	40.42	34	46.66	6	21.61	36	27.97	51	27.65	64	20.00	43	41.58
Bulls	0	.00	0	.00	0	.00	10	53.33	0	.00	10	84.00	0	.00	0	.00	0	.00	0	.00	11	28.58	3	54.44
Older steers	0	.00	11	45.02	0	.00	0	.00	1	59.00	0	.00	0	.00	0	.00	0	.00	2	35.90	0	.00	1	44.72
Total number and average price	254	22.56	166	22.12	219	31.32	227	34.37	627	44.00	422	41.19	473	30.21	460	20.16	476	14.64	496	16.83	433	15.28	387	26.93

[1]Gross receipts f.o.b. shipping point. See footnote *b*, p.

[2]Average amount of sales in dollars obtained by dividing the sum of annual receipts by the sum of annual numbers sold.

and although these were not sold until 1935, they were included in the 1934 account, in order to complete the records. They were credited at $18 a head as of December 31, 1934, based on estimated Santa Rita sale value for that date.

An effort was made to cull the breeding cows at the rate of about 10 percent a year, based on the theory that the productive life of a cow is 10 years. This plan called for about 40 displacements a year. The average was 43, for a herd that averaged 394 cows for the 11-year period. In 1925 and 1926 few displacements were made, owing to rather low market prices of cows. Hence the heavy displacements in 1928 and 1929. The general plan of selling cows 1 or 2 years before expiration of their period of usefulness allows for holding them that much longer if and when it seems advisable to do so.

Age of Animals

Closely related to classes of cattle, with reference to marketing, is age of animals. Distinct advantages were gained when, in marketing, the animals, particularly the calves, were sold in as large and uniform lots as possible, grouped according to age and also size. These are two good points to keep in mind when marketing any class of livestock.

Another marketing advantage consisted in selling cows while they were still in fair or good condition—that is, before they reached the canner stage.

Time of Marketing

Owing to the fact that the range produce were sold largely as calves most of the sales were made in the fall and early winter, when they reached the ages of 8 and 9 months. In fact, 80 percent of all animals of all classes were sold then.

The principal advantage gained in selling both young and old animals before the middle of winter was that then they were usually in excellent condition. Further, marketing at this time reduced the handling of cattle and also the total operating cost.

Needless to say that much handling of livestock, or more than is necessary, does not improve the condition of range cattle, nor does it add to the earnings of the breeding herd. Spring marketing, although advisable sometime, necessitates the handling of cattle when they are in poorer condition than at any other time of year.

Manner of Marketing

For the most part, the sales of the Santa Rita cattle have been to local buyers, as the advantages gained in this manner of marketing outweighed the disadvantages. On many ranges the major advantage lies in the fact that usually a rather small number is marketed at any one time. Few stockmen are in a position to follow the marketing "game" closely enough to take advantage of favorable market conditions. The average buyer, on the other hand, is able to keep in rather close touch with market movements, and knows the class of cattle in demand and also what prices he might expect.

Shipping Points

Until recently the shipping points for the Santa Rita range were Amado (10 miles away) and Tucson (about 35 miles distant). When the calves were marketed at Amado, most of the mother cows were driven with them to and from the shipping point, as is commonly done. When the shipping point was Tucson, the calves were hauled by truck, to avoid driving the mother cows this distant and back. Now there is a shipping point near Continental, just outside the experimental range. This eliminates the driving of cattle long distance, for such driving reduces herd earnings, because of extra labor cost and shrinkage in cattle weight.

The Santa Rita district may be regarded as having exceptionally good market advantages, because it is in a productive range-cattle center and is near the largest single cattle-finishing area in the Southwest, namely, Salt River Valley.

Other Factors Affecting Earnings

Every effort was put forth to make the Santa Rita herd efficient by reducing its "carrying load" as much as possible. As on other ranges, this herd carries all the running expenses, bull costs, and other costs for improvements and the like. On many a range it carries in addition an excess load of "cut-backs" or "carry-overs", saddle horses, and aged steers. Cattlemen should be mindful of the fact that these excess animals consume large quantities of forage, and that the more forage they consume, the less there will be for the breeding herd. With respect to this problem, the guiding principle on the

Santa Rita range may be stated as follows: A range is most productive when, within conservative limits, as much as possible of the forage produced is used by the breeding cows and when the least is consumed by non-productive old cows, aged steers, and unnecessary horses. Probably there are many ranges that could be made profitable, or more so, were the excess loads reduced, and the forage thus gained serve to give assurance of adequate forage over periods of years.

Annual Rainfall in Relation to Costs and Earnings

In planning for sustained grazing capacity, whether on this or any other semidesert range, rainfall is the outstanding factor to be taken into consideration. Semidesert climate implies limited rainfall. For low country, the average annual precipitation varies from about 10 to 20 inches—on the Santa Rita range it varies from 12.6 to 18 inches, depending on elevation. Usually when the annual rainfall is about equal to or above the average, grazing conditions are good. But some years the precipitation may fall as much as 50 percent below the average, causing droughty conditions which result in short growths, thus necessitating special planning to meet such conditions. These dry years, which occur frequently, constitute an important problem not only in range conservation but in cattle operations as well.

On the Santa Rita range, the problem of dry years was met in the following manner: Up to 1929, stocking was based on the average yield of forage for a period of years, including years of diminished rainfall. In addition, some forage was held in reserve (as pastures) to meet emergency needs. At the close of 1928, previous pasture-

utilization records showed the necessity of leaving at least 15 percent of the forage as reserve. Thus beginning with 1929, the stocking was based on 85 percent of the average forage yield, leaving 15 percent as a drought safety factor. Such a program allowed this range to build up reserves during good years. Some injury to the grasses resulted during drought periods of two or more years. Recent research on the Santa Rita range has shown that it is far safer to provide a forage reserve of 20 percent, in order to preserve the vitality of the grasses.[9]

INVESTED CAPITAL IN RELATION TO COSTS AND EARNINGS

The capital invested in the Santa Rita operation herein considered is given, including cattle, improvements, and land, which together averaged $69.23 per cow (table 9). Of this amount, $45.11, or 65.2 percent, represent livestock, $22.50, or 32.5 percent, represent the value of all improvements used in the operation, and $1.62, or 2.3 percent, represent lands. The last item indicates a small acreage—about 240 acres in all—which consisted of the operator's headquarters ranches.

The total investment of $69.23 per cow returned, on the average, $5.63 annually (table 3), which is equivalent to 8.13 percent earnings, exclusive of the amount credited as interest.

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[9]The results of this study have been included in a manuscript entitled "close grazing and forage production in relation to preservation of southwestern semidesert ranges." Publication pending.

Table 9.--Capital invested in a Santa Rita cattle-breeding operation

Item	Annual investment per breeding cow											Average[1]
	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Cattle[2]	43.91	45.23	33.40	56.66	86.00	52.36	52.35	31.72	30.30	28.25	31.33	45.11
Fences	6.26	6.85	4.17	5.37	7.41	8.44	7.47	8.40	10.32	9.57	11.93	8.29
Water developments	2.66	2.93	1.81	2.37	5.23	7.23	9.20	11.71	11.91	11.10	12.90	8.29
Headquarters buildings	2.32	2.49	1.49	1.86	3.31	3.79	3.17	3.45	3.16	2.92	3.49	3.05
General ranch equipment	.15	.09	.63	.46	2.35	2.03	2.79	4.84	4.29	4.07	4.25	2.87
Total	11.39	12.36	8.10	10.06	18.30	21.49	22.63	28.40	29.68	27.66	32.57	22.50
Land	2.13	2.58	1.76	2.57	1.30	1.60	1.44	1.43	1.42	1.43	1.81	1.62
Grand total	57.43	60.17	43.26	69.29	105.60	75.45	76.42	61.55	61.40	57.34	65.71	69.23

[1]Formed by dividing sum of annual amounts by the sum of annual numbers of cows.
[2]Saddle horses included.

Economic Limits of Investments and Improvements

As in most economic studies of this kind, the question of investment and improvement limits in this established operation came up. Here these problems were reduced to the practical question, Will any proposed improvements reduce the operation costs or increase the returns from the herd sufficiently to more than offset the cost of such improvements?

In this study the range improvements were Government owned, nevertheless they were charged against the operation at their full cost; and in years following completion, at cost less depreciation. The capital invested in fences, water developments, ranch equipment, and headquarters buildings—all a part of good range management—varied somewhat from year to year (table 9). During the first years, fences constituted a large part of the capital invested. In later years, as management plans were perfected, additional water developments were put in, making the investment in this class of improvements greater than that in fences. The fact that there is but little natural water on the Santa Rita range necessitated the development of additional sources, including four temporary earth tanks, numerous watering rims, five wells, and six steel storage tanks. (Figure 4.)

On some ranges the investment in fences might be a major item, whereas on others it might be water developments or lands. Whether cattle, water developments, fences, or lands constitute the major item of investment, it is important in profitable range management to keep in mind how much total capital invested is represented by each

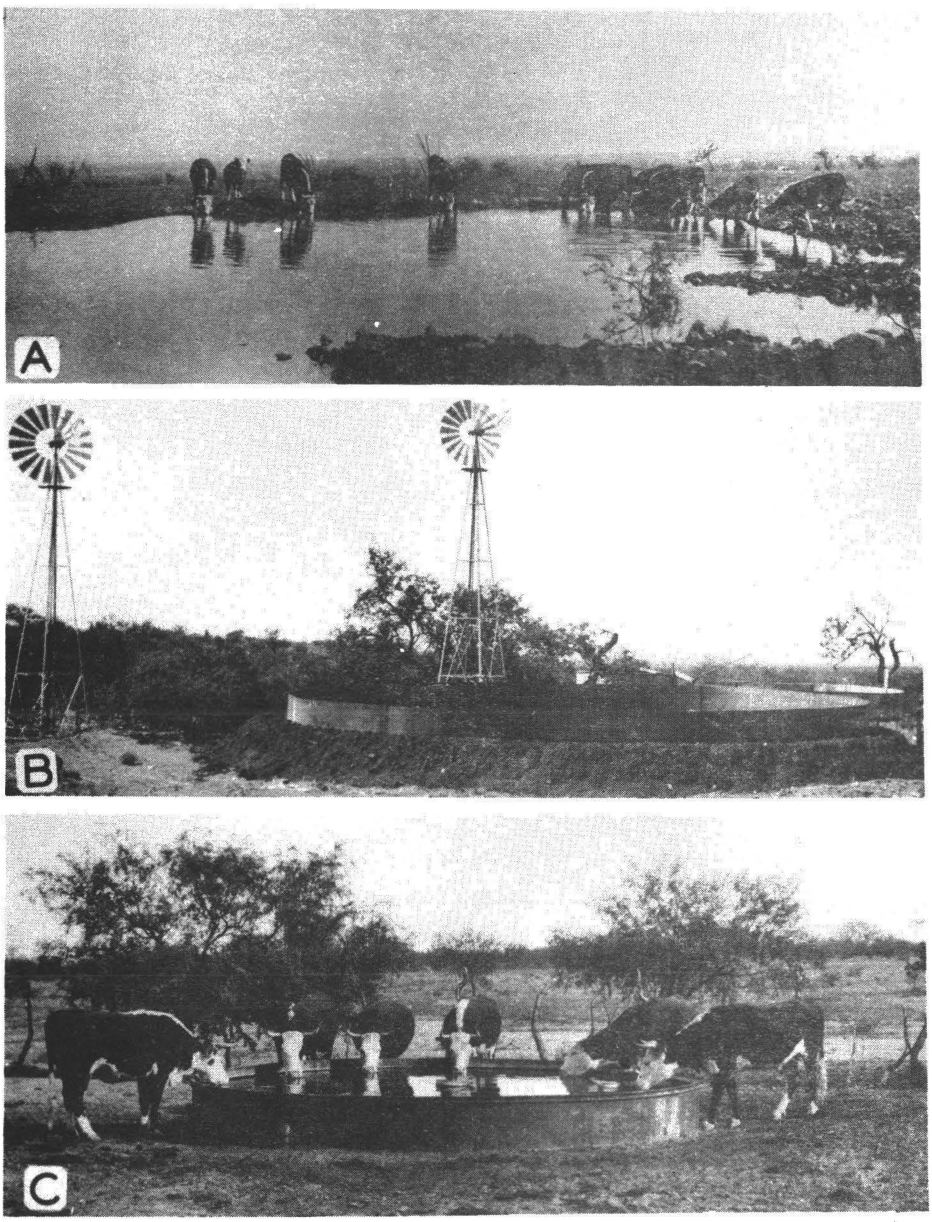

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Figure 4.—Water developments on the Santa Rita range. A, One of the temporary surface or earth tanks which are valuable aids in getting cattle onto areas that lie far from permanent waters. B, Permanent waters: shallow wells equipped with windmills, pumping engines, and storage tanks. C, One of the steel rims that constitute an important part of the permanent water system.

cow of the breeding herd (in this study, $69.23), inasmuch as the performance of each cow, in response to the character of management, determines the earnings. There is a limit in capital investment per cow beyond which it would not be possible to realize any profits within a reasonable length of time.

What Percent Calf Crop for Profit?

In this study it required, on the average, the sale of 173 calves—representing a 44-percent calf crop—to meet the cash expenditures alone. When all the costs are considered—running expenses and other charges (table 2)—it took the sale of miscellaneous cattle (cows, bulls, steers, and some yearlings) plus about a 60-percent calf crop to balance the account. Thus, on the average, a calf crop greater than 60 percent had to be produced before any net earnings could be realized. The average calf crop was greater than this by nearly 23 percent (82.7 - 60), which favorable difference made possible the 8.13-percent profit on the average investment of $69.23 per cow.

SUMMARY

A study was made of cattle breeding business on a yearlong, mixed-grass, semidesert range in southern Arizona, covering the 11-year period from 1924 to 1934, inclusive. Young range cattle, mostly 8- and 9-month old calves, constituted the principal product. The range unit comprised 24,700 acres which carried, together with bulls and other cattle, 394 breeding cows annually for the period.

Gross receipts for the breeding herd (high-grade Herefords) averaged $26.44 per cow; total costs (running costs and all other charges) averaged $20.81 per cow; and net proceeds, or earnings, averaged $5.63 annually, exclusive of the amount credited as interest.

When all running expenses of the operation are considered, plus all other charges, it cost, on the average, $25.11 to produce an 8- or 9-month-old calf.

The calf crop averaged 82.7 percent, based on the number of cows in the breeding herd.

Cattle losses averaged 2.8 percent annually. Of the calves, the operator lost only 2.9 percent, mostly from unknown causes.

Among the range practices that materially increased the herd earnings were (1) stocking on the basis of sustained yield, (2) regular fall-winter sales of high-grade calves, (3) reduction of "carry-overs", horses, and aged steers to the minimum, and (4) leaving an equivalent of at least 15 percent of the forage as a drought safety factor. Recent findings have shown that 20-percent reserve would be better.

The capital invested in the Santa Rita operation averaged $69.23 per cow. The net proceeds, or earnings, were equivalent to 8.13 percent, exclusive of the amount credited as interest.

It required, on the average, a 44-percent calf crop to meet the cash expenditures. A calf crop greater than 60 percent was necessary for profits.

On ranges stocked on the basis of sustained grazing capacity, production of the breeding herd translated into earnings per cow offers distinct advantages when one considers the economics of the cattle-breeding business.